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ABSTRACT

Exploring the relationship between strategy training and the child's apparent knowledge, this study assessed (1) whether the effects of rehearsal training without added metamnemonic feedback would be evident one week after training, and (2) the effects of specific training upon more general metamnemonic awareness. Initially 40 children 6 years of age participated in the study. Each subject was administered a serial recall task and was measured on overt rehearsal and success in the recall task. Each additionally was administered a metamemory task designed to fulfill Flavell and Wellman's 1977 classification of the constituents of metamemory. Scores were used to form three groups of subjects differing in the extent they rehearsed: "producers" who rehearsed on six or seven trials, semi-producers, and non-producers. Each of these groups was divided into two; half received training and half were controls. While control subjects were tested on the serial recall task again, the experimental group was tested and instructed to rehearse. Both groups were tested a third time after a week had passed. Comparisons of pretest and posttest data suggest that rehearsal training led to lasting increases in the use of rehearsal, improved recall, and greater expressed knowledge of metamnemonic awareness. Improved recall was particularly evident among those 6-year-olds who did not spontaneously rehearse. Results contrast with findings of previous studies. (RH)

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Training Children to Use Mnemonic Skills: What Causes Improvements in Memory Performance?

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Introduction

As Charles Hulme (1986) has recently pointed out, much of the recent spate of memory research has derived from cognitive psychology. Strategies like rehearsal and the semantic organisation of the child's memory are the primary focus of research. At the same time Piagetian theory has influenced discussion about and studies on metamemory (our knowledge about the workings of memory and its usefulness [Flavell, 1971]). In this paper we will consider both these aspects of memory and the issues involved in their measurement. We will discuss an experiment which examines rehearsal training in six year olds and its influence on metamnemonic awareness.

We selected rehearsal as it is regarded as a key strategy in memory development (Brown et al. 1983). As Flavell and his colleagues (1966) showed twenty years ago the use of overt rehearsal increases rapidly from five to ten years - thus most six year olds are relative novices (Kunzinger and Witryol, 1983). Despite criticism of the concept of metamemory, research in this area has shown a similar developmental progression - younger children appear to be relatively unaware of their own memory abilities (Appel et al. 1972;Kreutzer et al. 1975).

As a result there has been much theoretical speculation about the influence of strategies like rehearsal (Naus and Ornstein, 1983) and knowledge of memory (Wellman, 1983) upon its development. Yet causal inferences like these are hard to establish given a heavy reliance upon cross-sectional research (Cavanaugh and Perlmutter, 1982; Kunzinger, 1985). One way of examining developmental change involves training children to use particular strategies and this study follows a number of microgenetic analyses (cf Vygotsky, 1978) of strategy

learning.

Rehearsal training studies tell us little about **lasting** change, since they measure improvements only minutes after training (Kennedy and Miller, 1976; Ringel and Springer, 1980), or find that young children do not continue to use taught strategies (see Kail, 1984). However, a large bulk of research (see Brown et al 1983) has been successful in improving recall (Keeney et al., 1967; Kramer and Engle, 1981), supporting the Vygotskyan notion of a shift from inter- to intra-psychological functioning, resulting from training. Just how such change takes place is still open to question. Many assume that domain specific experience simply leads to domain specific competence. Yet, on closer examination, the evidence suggests that feedback from the trainer is essential for maintaining the effects of training (Kennedy and Miller, 1976; Paris et al 1982) - in other words that change occurs when the child both learns a skill and understands its utility.

This experiment considers the relationship between strategy training and the child's apparent knowledge, by examining more than the rather narrow relationship between a skill and knowledge of that skill. We assess, firstly, whether rehearsal training, without added metamnemonic feedback, can be successful one week after training and, secondly, the effects of specific training upon more general metamnemonic awareness. We will start by describing the measures we used.

The Serial Recall Task

Like a Free Recall task, the Serial Recall Task which we employed was designed to elicit spontaneous verbal rehearsal (Glanzer and Clark,

1963; Ranken, 1963). The child simply had to recall the order in which previously displayed items - pictures in this case - were presented by the experimenter.

Slide 1 here

In the context of a game, she was shown a tray of six pictures mounted
on cards; the experimenter pointed to a set number of pictures in succession;

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the tray was covered for fifteen seconds during which the experimenter moved every card so that spatial location did not aid memory.

Slide 2 here

The child was then asked to point to the pictures in the same order that the experimenter had pointed to them. Two practice trials with three items were given to ensure that the child understood the task. These were followed by 7 trials - one with two pictures and two with 3, 4 and 5 pictures.

We took two measures of the child's performance. Firstly, we

recorded whether or not a subject overtly rehearsed using lip movements or vocalisation.

Children were allocated to one of three groups (1) "Producers" who rehearsed on six or all seven trials (2) "Semi-Producers" who rehearsed on between two and five trials and (3) "Non-Producers" who neither rehearsed on more than one trial nor reported doing so when asked after the trials had finished. Only one child who failed to rehearse overtly claimed to be doing so. She was classed as a semi-producer. Secondly, the child's success on each trial was recorded, giving her a maximum possible score of seven points.

The Metamemory Task

In keeping with recent discussion of metamemory tasks (Cavanaugh & Perlmutter, 1982; Wellman, 1983) we designed a metamemory test which included measures of a variety of metamnemonic skills.

OH 1 - memory limitations

Firstly, we examined the child's knowledge of the limitations on memory by presenting two cards in which a boy is examining either six pictures or four pictures. Having been shown the differences between the two cards, she was asked; "Which boy will find it hardest to remember all his pictures?" and then, as with the following items, "why?".

Secondly, knowledge of memory decay was assessed by asking a simple question about the possible effects of distraction on memory performance - for example, watching a television programme having

been given a telephone number.

OH 2 - related v.unrelated items

Thirdly, when presented with two pictures, one with related items, the other without, the child had to decide which is the harder to recall.

OH 3 - rehearsal

Fourthly, the subject was shown pictures of two boys inspecting identical arrays. One was rehearsing, the other not. Again the child was asked which boy would find it harder to remember the pictures.

OH 4 - memory monitoring

Finally, examining a picture of a boy looking at six items, the child was told that the boy had previously forgotten three of these items, and the experimenter pointed at them. The subject was then asked to choose the three pictures which the boy should look at again in order to remember all six better.

OH 5 - complete metamemory scale

These tasks may seem familiar since they were derived from major metamemory studies and were designed to fulfil Flavell and Wellman's, 1977 classification of the constituent parts of metamemory.

The metamemory questions were scored as follows:- one for a correct answer, three for a clear justification of choice and two for a partially correct justification. On our scale of metamemory, a total score of 15 was possible.

We are aware that most of these metamemory questions are open to alternative interpretations - for example, some might argue that simple maintenance rehearsal may in some circumstances impair, rather than improve, recall (viz. phonological confusion or rehearsal versus rehearsal set size). However, there were no instances where a child selected the wrong picture, but gave an answer that showed awareness of such issues.

Procedure

OH 6 - procedure

Initially forty six-year-olds participated in this study. During the first week we screened the children to exclude those who confused linguistic terms like "remember", "same order" and "hardest" (none did) and gave them the serial recall and metamemory tests. Their overt rehearsal strategies were recorded and they were divided into eleven 'producers' (those who rehearsed on six or seven trials), twenty semi-producers and nine non-producers. Each of these groups

was divided into two with half allocated to training, the remainder to a control group.

In the second week the control group was tested on the serial recall task for half an hour. The experimental group was tested for a similar length of time on the same task but was instructed to 'keep whispering the names (of the items) over and over again until I ask you to point to the pictures; being prompted again whenever they failed to do this. In the third week all subjects carried out the two tests again. To reduce practice effects, we designed two sets of stimuli for each test. All the children used one set of cards for the serial recall task during pre-test and training and another at post-test. Each set of metamemory questions was given to half the children in week 1 and the other half in week 3.

Results and Discussion

For the sake of simplicity we will focus upon comparisons between pre-test and post-test data in this discussion.

OH 7 - table with rehearsal data

If we start by examining the amount of overt rehearsal by children in the training and control groups, we see that trained subjects rehearsed in significantly more trials at post-test (a week after training) while control children rehearsed in significantly fewer trials. As this table suggests, improvements in the trained group were made by semi-producers and non-producers.

On the pre and post test data, where both the serial recall and metamemory measures were taken, we performed a repeated measures MANOVA on the two tests using training v. control and the three rehearsal production groups as the between subjects factors. In short, all main effects were significant and we will discuss only the consequent univariate analyses here.

OH 8 - table with serial recall data

Having divided the children into the training and control groups according to the rehearsal strategies which they originally used, we found no differences between these groups in their initial serial recall performance. The recall of Producers (those who rehearsed actively in most trials) was significantly greater than that of the other two groups (as measured by post hoc Student-Neuman Keuls tests). During training the experimental group improved and they recalled significantly more than control children. As this table shows, one week after training this pattern continued. The data also suggests that the performance of semi-producers and non producers accounts for the greater recall in the experimental group.

OH 9 - table with metamemory test data

Initial metamemory test scores showed no differences either between the training or control children or between the three rehearsal production groups. However, at post test the group trained in serial recall had significantly higher scores than the controls.

Thus, these results suggest that rehearsal training leads to lasting increases in the use of rehearsal, improved recall (particularly in those six year olds who do not spontaneously rehearse during such tasks) and greater expressed knowledge of metamnemonic awareness. What might account for such clear results?

In order to answer this question, we made two checks on our data. Firstly, we intercorrelated the children's pre and post test serial recall and metamemory scores to see if the effects of training may mask other influences on our post test data. Initial serial recall and metamemory test scores did not correlate with either post test result.

Secondly, we examined whether trained children's improvements on the metamemory test could be accounted for simply in their response to the question concerning rehearsal - perhaps training leads to specific increases in metamnemonic awareness? This proved not to be the case. On every item in the metamemory test experimental children improved more than control children. (At post test one item showed such a difference between the trained and control children that this difference was statistically significant - the measure of memory monitoring. All but one of the trained children knew that it was better to examine previously forgotten words.)

These checks on our data still lead us to the conclusion that this experiment shows far reaching effects of rehearsal training. The results contrast with the previous findings that domain specific experience gives rise to domain specific expressions of ability and that metacognitive training is the key to such specific developments. The occurrence of metamemory test improvements in the trained group

militates against a straightforward relationship between knowing and doing. We are not inclined to interpret these data directly, to suggest that specific training effects change in the child's general memory abilities. Such a conclusion seems absurd given, firstly, the very limited nature of this training and, secondly, the research which shows that children rarely adapt a newly learned skill to master a slightly different task (Kramer and Engle, 1981).

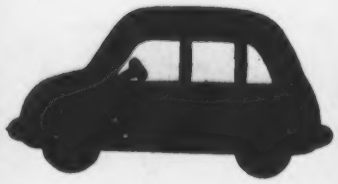
We feel that it is foolish to make assumptions about the child's cognitive development without first considering the nature of experiments like these. Rather than devising a neat model of learning based on these results we prefer to reflect upon the two possible features of this experiment which might have effected or caused these results. In the first place, it is possible that the experimenter unwittingly influenced the children's responses. As in other experiments of this kind, one person (G.D.) acted as both trainer and tester. We know from Simon and Smith's (e.g. 1983) seminal research on experimenter influences on play and learning that such influences can occur. However, in keeping with other studies of this kind, we did not take this possiblility into account. We suggest that a replication which controls for the Clever Hans effect should be done before we draw any definite conclusions from the study.

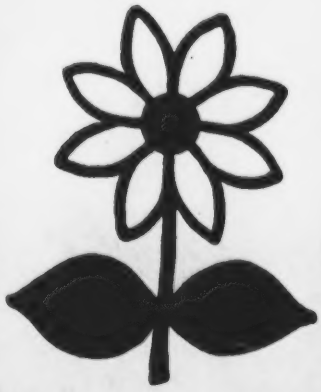
Secondly, we feel that results such as these should be examined within the context of the interaction between experimenter and child. Recent discussion of metamemory has increasingly focused upon what are termed 'subject variables' - the child's motivations and beliefs about memory which are an integral part of her metamnemonic awareness (Brown et al., 1983; Cavanaugh and Permutter, 1982; Paris et al., 1982). Such 'variables' do more than inform the child about the appropriateness of particular strategies. For example, Kunzinger and

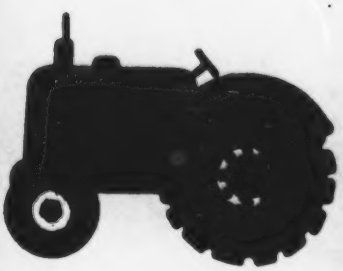
Witryol (1983) have shown the effects of financial rewards upon the child's memory performance. This experiment also revealed differences in the ways trained and control children approached the post test. The supposed improvements caused by training may be equally well explained by the apparent deterioration in the performance of control children in the post test - a 'screw you' effect might explain their lower rehearsal scores in the post test. Similarly, the enhanced performance of trained children in the post test may reflect increased knowledge of the requirements imposed by the experimenter - the games she plays - rather than an increase in the child's more general knowledge of memory.

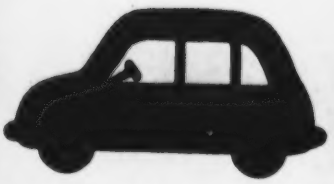
We conclude by suggesting that experiments like this are essentially social events and should be examined as such. We noted during testing that control children seemed bored by repeated testing. Perhaps researchers in this field should examine the nature of child-experimenter interactions to measure more precisely the social context of the child's memory performance. Taking a lead from other areas of developmental research we suggest that research on memory development should have its social foundations.

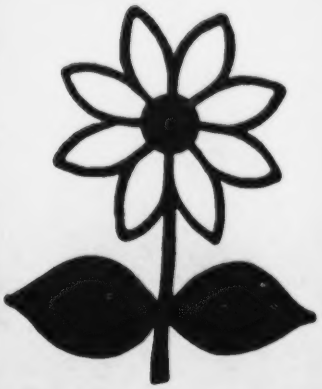
SLIDE 1



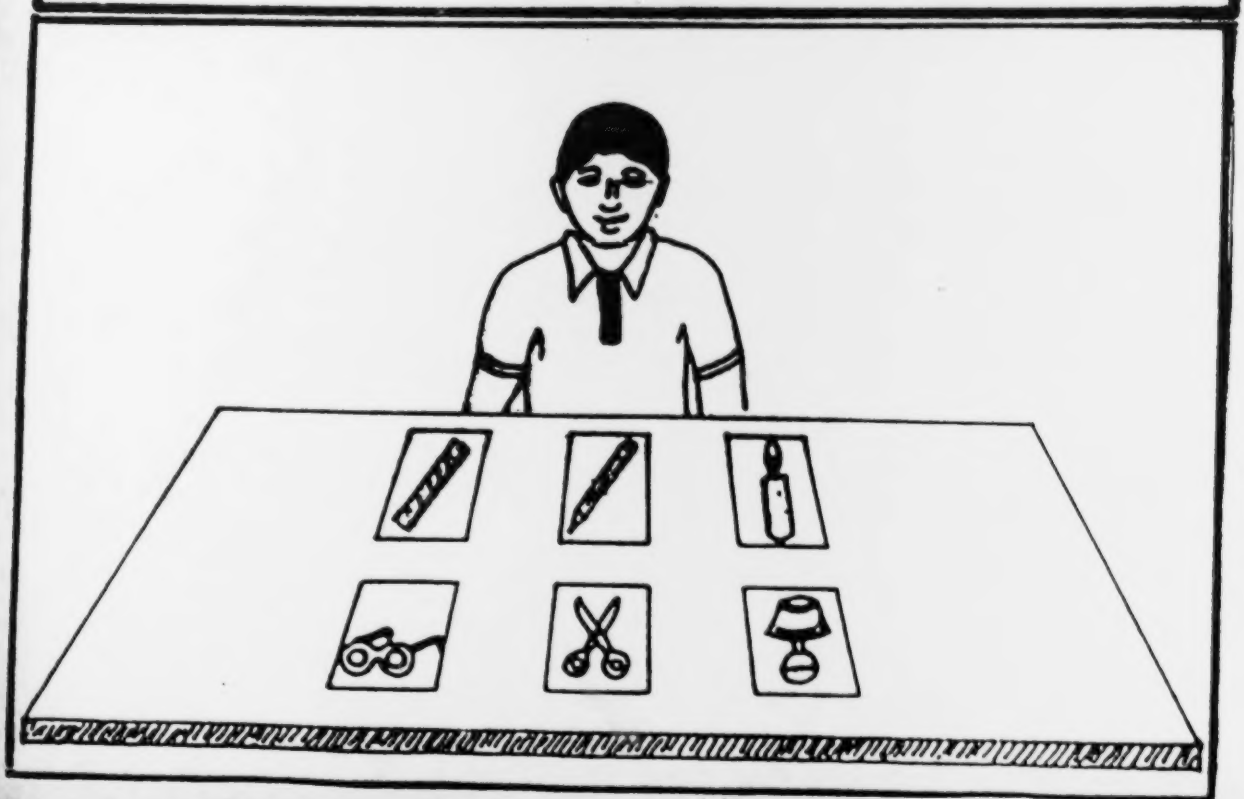




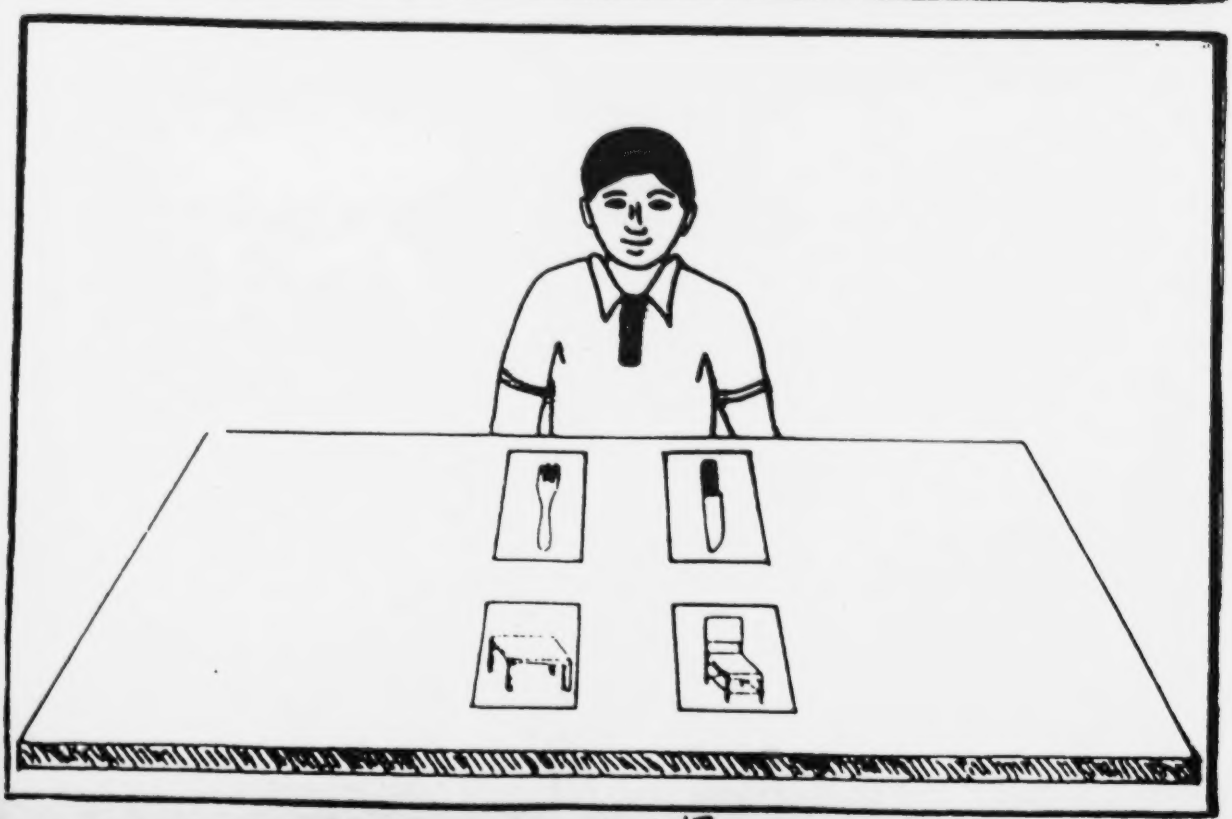




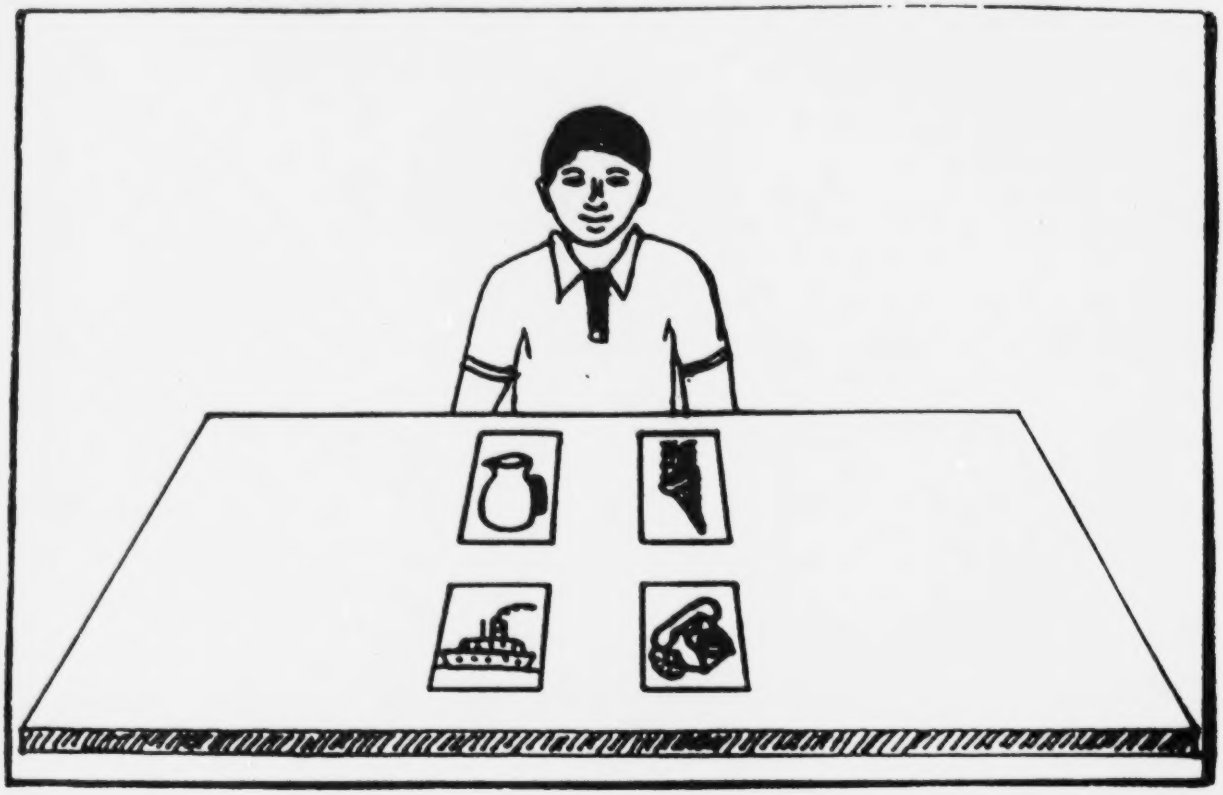
Knowledge of Memory Limitations



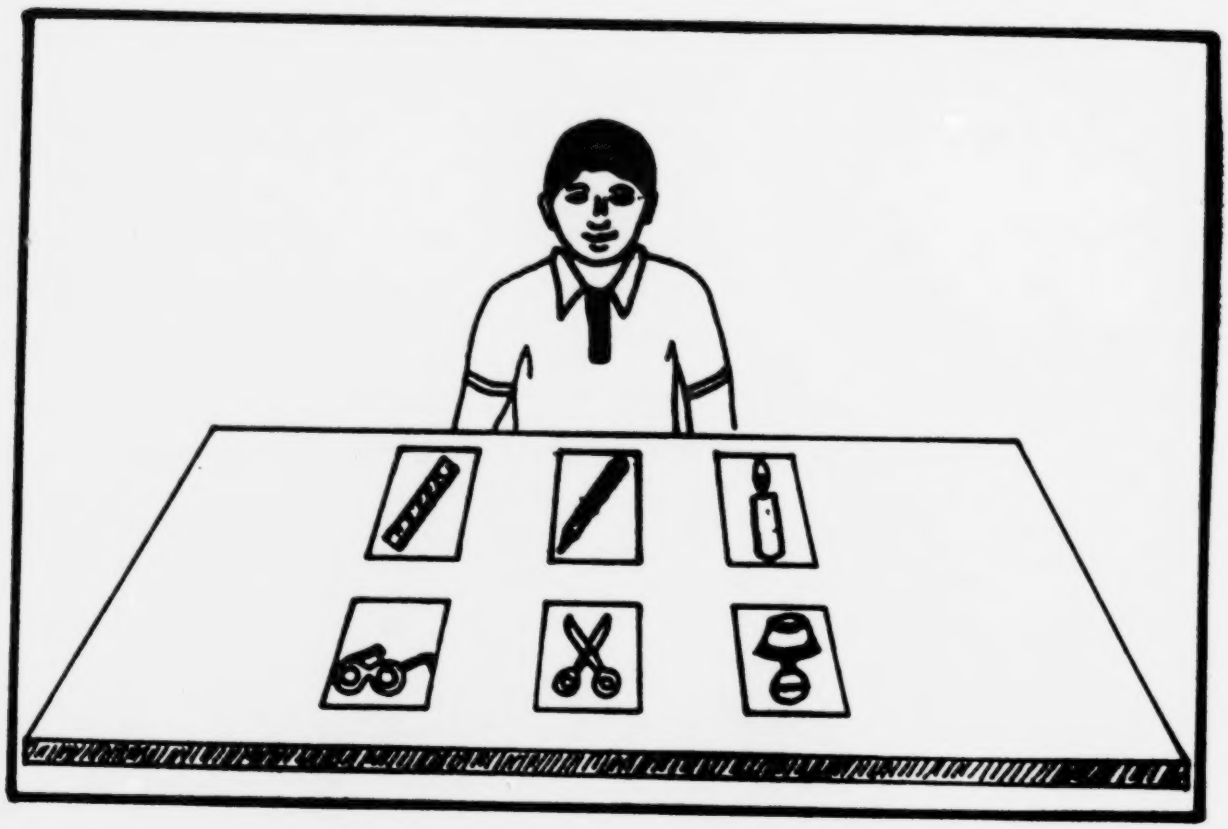
Related vs. Unrelated Items



Use of Rehearsal



Memory Monitoring



Complete Metamemory Scale

SOURCE	TESTS KNOWLEDGE OF:	EXAMPLE
Wellman 1976 Yussen and Bird 1979	Memory Limitations	Is it harder to remember 6 or 4 items?
Kreutzer et al 1975	Memory Decay Over Time	Effects of distraction after being told a 'phone number
Kreutzer et al 1975	Remembering Related vs. Unrelated Items	Which items are harder to recall (1) knife, fork, table, chair or (2) television, house, book, elephant
Wellman 1978	Usefulness of Rehearsal	Which boy remembers more: (1) one who rehearses overtly (2) one who just looks at pictures
Masur et al 1973	Memory Monitoring	When reexamining stimulus pictures do you examine:- (1) those previously forgotten (2) any pictures at random

Study Details

Subjects

20 boys and 20 girls: mean age 6.7 yrs (75-86 months)

Procedure

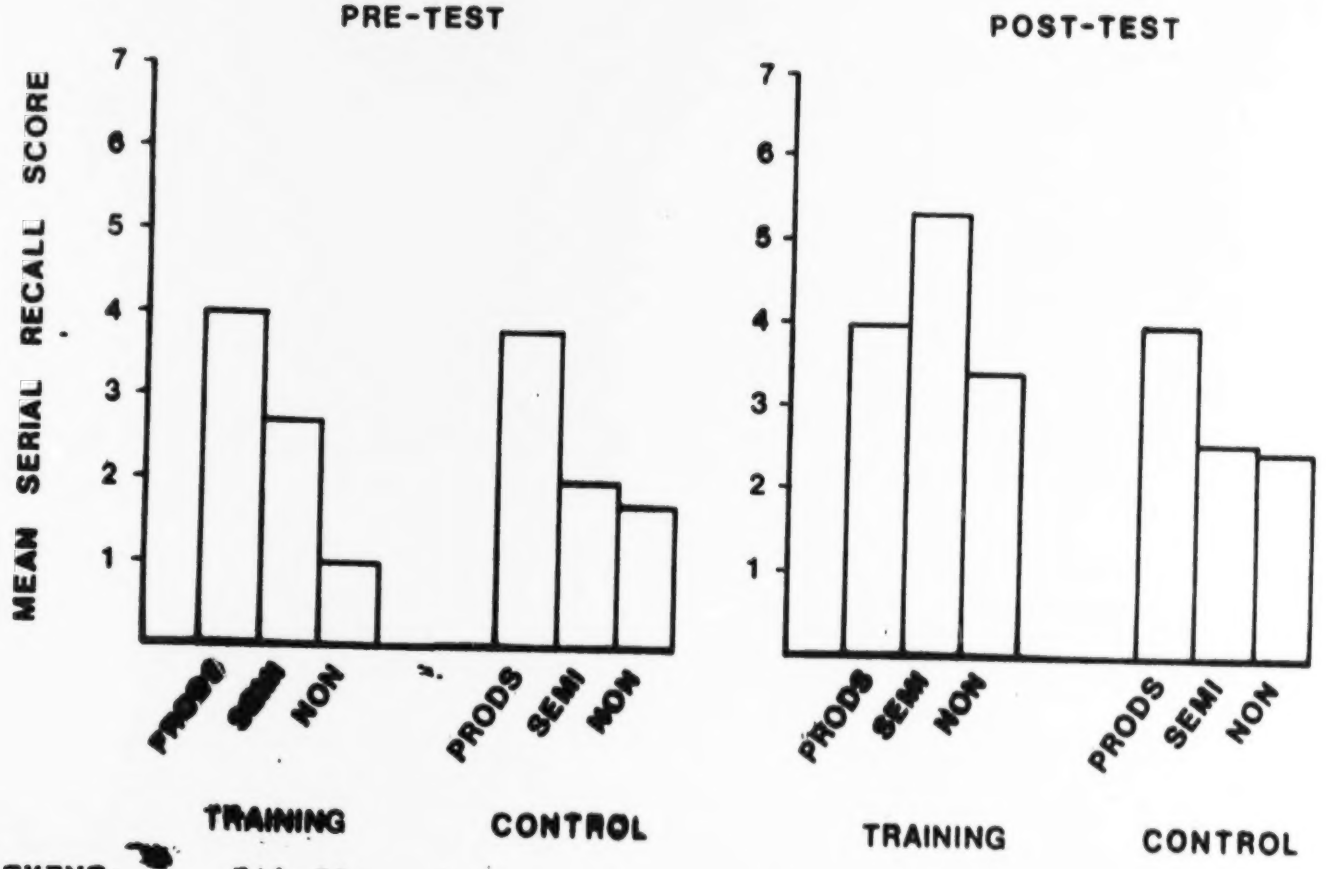
Pre-test (Week 1)	Training (Week 2)	Post test (Week 3)
Clarification of linguistic terms: - 'remember' and 'same order' in serial recall task. - 'hardest'/ 'easiest' in metamemory task.	Serial Recall Task:- Rehearsal Training OR Testing	Metamemory Task Serial Recall Task
Serial Recall Task		
Metamemory Task		

MEAN NUMBER OF REHEARSALS FOR THE DIFFERENT PRODUCTION GROUPS PRE- AND POST-TEST (MAXIMUM = 7)

TRAINING GROUP		
	PRE-TEST	POST-TEST
PRODUCERS	6.25	6.25
SEMI-PRODS	2.80	5.20
NON-PRODS	0.80	4.40
	T = 2, N = 14,	p < 0.0002

CONTROL GROUP		
	PRE-TEST	POST-TEST
PRODUCERS	6.50	6.20
SEMI-PRODS	3.22	2.22
NON-PRODS	0.50	1.75
	T = 4, N = 13,	p < 0.05

MEAN SERIAL RECALL SCORES FOR THE DIFFERENT PRODUCTION GROUPS PRE- AND POST-TEST



TREATMENT: F(1,32) = 0.01 NS
(Training v Control)

PRODUCTION GP: F(2,32)= 9.97, p<0.001
(Producers v Semi v Non)

INTERACTION: F(2,32) = 1.08 NS

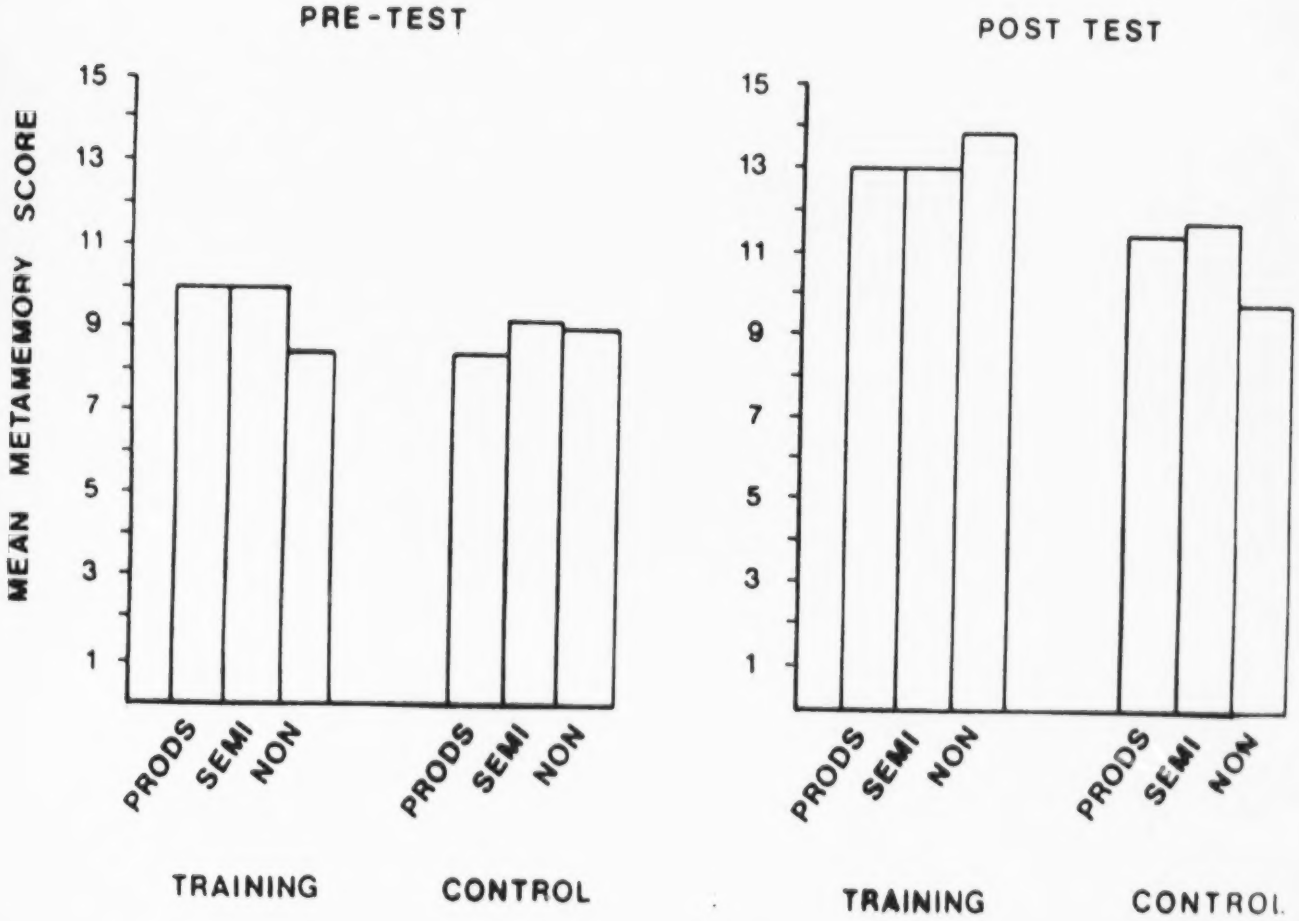
TREATMENT: F(1,32) = 6.11, p < 0.05
(Training v Control)

PRODUCTION GP: F(2,32) = 1.88 NS
(Producers v Semi v Non)

INTERACTION: F(2,32) = 3.16, p = 0.05

OH 9

MEAN METAMEMORY SCORES FOR THE DIFFERENT PRODUCTION GROUPS PRE- AND POST-TEST



TREATMENT: F(1,32) = 0.32 NS
(Training v Control)

PRODUCTION GP: F(2,32) = 0.25 NS
(Producers v Semi v Non)

INTERACTION: F(2,32) = 0.28 NS

TREATMENT: F(1,32) = 6.10, $p < 0.05$
(Training v Control)

PRODUCTION GP: F(2,32) = 0.16 NS
(Producers v Semi v Non)

INTERACTION: F(2,32) = 0.75 NS